Designing Organizations for Innovation in Transitioning Domains

Doctoral Dissertation by

Madis Talmar

DESIGNING ORGANIZATIONS FOR INNOVATION IN TRANSITIONING DOMAINS

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Designing organizations for innovation in transitioning domains

MADIS TALMAR

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Abstract

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Abstract
Operating in so-called socio-technical transitions sets high requirements to organizations. In the course of a transition, which typically spans several decades, existing organizations, products, services and business models are structurally challenged, while opportunities for more sustainable new technologies, products, services, business models and organizations emerge. Survival and success in transitioning domains thus inherently depends on the ability of organizations to adapt to changing conditions and to continuously innovate; that is, to renew their product and service portfolios, business models and organizational structures. Against this background, this dissertation investigates the topic of organization design for innovation in transitioning domains. The central question of the dissertation is: How to design organizations that succeed at innovation in transitioning domains? The dissertation tackles the central research question from the viewpoint of three distinct organizational profiles, each having a key role in transitioning domains: ventures, incumbents and systemic intermediaries.

In study one, we theoretically develop design propositions regarding the strategies of ventures pioneering path-breaking innovation in orchestrating an innovation network toward higher socio- technical acceptance of the product-service (system) commonly achieved by that network. In study two, we perform a systematic literature search and synthesis to develop design principles for building an organizational system for major innovation in incumbent firms. We proceed by contextualizing the resulting general framework of several hundred interlinked design principles toward a design solution specifically for power utility firms. In study three, in a qualitative longitudinal case study, we study the evolution of a systemic intermediary organization with regard to their transition-support activities. From the case study, we destil a design solution for dynamically managing and governing the activities of systemic intermediaries. Finally, study four distinguishes from the other studies in that we develop a design theory that encompasses a method for mapping, designing and analyzing (i.e., modeling) innovation ecosystems, regardless of the organizational profile performing these activities. As such, the fourth study targets a methodological contribution to organization design to fulfill a practical, as well as a scholarly need for analytical tools on innovation ecosystems.

Overall, the dissertation makes three main contributions. First, it contributes to transition studies by building the foundations for, and demonstrating the relevance of organization design as a distinct area of inquiry within transition studies. Second, we build the foundation for considering one type of networked organization: the innovation ecosystem (within the structuralist perspective) as an object of design. Third, we carry over from management information systems research to organization and innovation studies the concept of design theory as an integrated boundary object.

Keywords
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I became a journalist because I did not want
to rely on the press for information
–Christopher Hitchens

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I am or have done would not have been possible without your tireless support. With the PhD assuming my move abroad, I know that it has not been easy for you. But know that near or far, I will always be guided by the values you brought me up with. They have not failed me.

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***

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INTRODUCTION

1.1 Background and scope

Due to grand problems such as climate change, pollution and natural resource depletion, societies are facing fundamental sustainability challenges that span several domains, including energy, food, infrastructure and mobility. To sustain biodiversity, resource availability and ultimately the viability of civilization, significant adjustments need to be made with regard to the environmental impact of human practices in these domains. New technologies can significantly contribute to instituting more sustainable societies; however the challenge is more than solely a technological one. History has shown that purely technological sustainability solutions often result in partial and largely short-term fixes due to negative externalities, rebound effects and other unintended consequences (Farla et al., 2012). In order to guide the transformation of a society toward a significantly more sustainable configuration, it thus is necessary to undertake a so-called socio-technical (or system-level) transition (Kemp, 1994). This involves fundamentally restructuring the socio-technical systems of both production and consumption (Geels, 2004). As such, a socio-technical transition profoundly impacts a wide variety of actors. In the course of a transition, which typically spans several decades (Geels, 2002), existing organizations, products, services and business models are structurally challenged, while opportunities for more sustainable new technologies, products, services, business models and organizations emerge (Fischer and Newig, 2016; Geels, 2010; Huijben and Verbong, 2013).

On the one hand, individual organizations are subject to the changing dynamics in the broader systems, which can significantly restrict their activities, and even influence their survival (Geels, 2004). On the other hand, transitions are the result of actors exercising their agency; that is, even though most organizations rarely have planning horizons and life cycles that extend over the whole period of a transition, they can have a critical role that affects the speed and dynamics of how a transition progresses or fails to do so (Raven et al., 2011).

Regardless of whether an organization is more a transition 'taker' or a transition 'maker', operating in transitioning domains implies it has to meet a high level of expectations and requirements. Most notably, survival and success in transitioning domains inherently depend on the ability of organizations to continuously innovate: to renew their product and service portfolios, business models and organizational structures (Van Lente et al., 2003). Against this background, the dissertation investigates the topic of organization design for innovation in transitioning domains. The central question of the dissertation is:

HOW TO DESIGN ORGANIZATIONS THAT SUCCEED AT INNOVATION IN TRANSITIONING DOMAINS?

Organization design is defined here as "the deliberate process of configuring structures, processes, reward systems, people practices and policies to create an effective organization capable of achieving its goals" (Galbraith, Downey, and Kates, 2001, p. 2). This definition of organization design has several implications for the dissertation. First, the primary unit of analysis is that of organizations. The socio-technical transition as such thus constitutes a specific context within which organizations or organizational processes are designed, without becoming the central phenomenon of investigation, as is common in transition studies (e.g., Geels, 2002; Kemp, 1994; Raven, 2007; Verbong and Geels, 2007).

Second, while the focus of the dissertation is on organizations, there is significant variance as to what exactly an organization is. The classical view on organization design has assumed the design activity to target a particular legal entity, such as a firm. However, designing contemporary organizations involves significant elements of cross-entity interactions (Baldwin, 2012), to the extent that sometimes an organization can be considered to lie almost completely in the interface of different entities (Parker, Van Alstyne, and Jiang, Forthcoming). Therefore, what bounds the domain of organization design more so than the focus on entities, is the purpose to achieve a specific goal(s). Or put otherwise, it is the affiliation to the goal(s) that separates what is inside and what remains outside the organization (Adner, 2016). Depending on the exact context, in the studies included in this dissertation, organization design is applied to distinguishable legal entities or to organizations where the locus of activities lies at the interface of several legal entities.

Finally, the definition implies that organization design is a deliberate activity. The 'designer' performing organization design is most typically the executive and/or supervisory board of the organization. Correspondingly, as also reflected in the central research question, the dissertation is prescriptive by nature, aiming to develop theoretical insights from the point of view of managers, as well as to make comprehensive contributions to managerial and governance practices directly.

This dissertation includes four distinct studies, each contributing to answering the central research question by raising and addressing a particular contex-

tualized sub-question. In defining the sub-questions, we departed from the position that design of organizations to better operate in transitioning domains is a thoroughly new area of academic inquiry. Meanwhile, there are several distinct profiles of organizations that are impacted by, and that themselves impact a transition (Fischer and Newig, 2016). Therefore, to open and explore parallel avenues of research into this topic, the key element that varies from study to study is the profile of the organization which is subject to organization design. In defining these profiles, we drew from transition studies three key actor classes, each embedded in the context of a socio-technical transition in a specific way (Raven, Van den Bosch, and Weterings, 2010). These include (1) incumbent organizations that, challenged by newcomers or pressurized otherwise, are seeking to develop a capability for major innovation to retain their relevance; (2) ventures that are advocating a path-breaking innovation; and (3) systemic intermediary organizations, who facilitate transition processes by structurally supporting the emergence and scale-up of major innovations in the form of new technologies, products, services and business models.

First, there are incumbent organizations, referred to also as regime actors (Turnheim and Geels, 2013). Having invested in the existing systems of production and consumption, incumbents are incentivized to prefer incremental improvements that build on existing technologies, artifacts, rules and habits in use (Tripsas and Gavetti, 2000). As a result, by default, incumbents typically seek to sustain the established socio-technical regime, and support the elements that keep a socio-technical domain (such as energy) on a certain developmental path (Geels, 2004; Kemp, Loorbach, and Rotmans, 2007). However, in case their previously successful lines of business are eroding (or made to erode by a policy intervention), regime organizations can also become highly interested in exploring novel developmental paths in society as a means to retain their business (Raven, 2007; as well as in one of the studies of this dissertation). In reference to the central research question of the dissertation, we consider that for incumbent organizations success at innovation means to be able to repeatedly generate (technological, product, service and/or business model) innovations that succeed at the market place, ultimately retaining or improving the position of the organization within the respective (transitioning) domain.

Second, there are ventures, seeking to develop and commercialize new technology, the basis of which often originates in universities and research institutes (Raven et al., 2010). Ventures act as key change agents within (socio-technical) niches, where changes to the regime-set developmental path of a domain origi-

nate. A niche stands for the set of technologies and related rules, habits and institutions that are held up by a cross-functional group of organizations and individuals seeking to institute an alternative developmental path to the regime in a domain (Geels, 2004). The distinguishing feature of a venture that pioneers path-breaking new technologies, products, services and/or business models is that, as niche actors, these organizations start at a structural disadvantage in the face of the regime (Van den Bergh, Truffer, and Kallis, 2011). However, the prospect of furthering a societally desirable cause—for instance sustainability—can provide niche-level actors a protective space for nurturing and growing a development path to overtake a dominant regime (Rip and Kemp, 1998; Smith and Raven, 2012). In reference to the central research question of the dissertation, we consider that for ventures advocating a path-breaking innovation success at innovation means to achieve societal and commercial support for their innovation.

Third, even though ventures and individual projects provide the variation that can be the basis for restructured production and consumption systems, destabilizing existing socio-technical systems and scaling niche-level variance to mainstream practices is a difficult and long process. To be successful, this process requires some degree of orchestration on the niche level (Geels and Deuten, 2006; Geels and Raven, 2006; Kivimaa, 2014). Thus, in converging the activities on the niche level and in supporting the niche in its interactions with the regime, niche actors can benefit from the existence of systemic intermediary organizations (Van Lente et al., 2003). Intermediaries rarely develop technology, products/services or new business models themselves (Kivimaa et al., 2017), however they mediate, facilitate and support other actors, such as ventures and research institutes, in fulfilling these functions. As such, systemic intermediaries create value by bridging systemic deficiencies in emergent innovation networks on the niche level (Klerkx and Leeuwis, 2009; Polzin, von Flotow, and Klerkx, 2016). In addition, intermediary organizations can also provide to niche level innovation shielding from mainstream selection pressures, as well as empower niche innovations in scaling up (Kivimaa, 2014). As such, systemic intermediaries often serve as important levers in public policy execution with regard to supporting the transition in a domain (Hamann and April, 2013). In reference to the central research question of the dissertation, we consider that for systemic intermediaries success at innovation means to be able to bridge systemic deficiencies on the niche level and provide systematic support to other stakeholders of the transitioning domain in their innovation activities toward reinforcing new (more sustainable) pathways in a socio-technical domain.

1.2. Researh questions per study

The four studies constituting this dissertation and the respective sub-questions are outlined in this section.

Sub-question 1

In the **first study (Appendix 1)**, we adopt the perspective of a focal venture pioneering a path-breaking innovation. We first identify the key barriers to instituting larger socio-technological change in society, including the inertia of the presently dominant socio-technical regime and the lack of clarity around which development pathways can lead to larger socio-technical impact. Addressing these barriers, we propose that a venture pioneering path-breaking innovation can leverage their innovation by seeking integration with the innovations originating in other organizations in what is called the innovation ecosystem (henceforth: ecosystem). The ecosystem is defined as a network of interdependent actors who combine specialized yet complementary resources and/or capabilities in seeking to (a) co-create and deliver an overarching value proposition to end users, and (b) appropriate the gains received in the process (definition developed in study one). As such, knowing what kind of value can potentially be created in the interaction of the venture and external actors, as well as how to pull these other actors along in doing so can be a valuable skill for a venture. These questions are far from straightforward though (Adner, 2016), and previous literature has lacked a focus on ecosystem orchestration strategies for ventures pioneering path-breaking innovations.

To fill this gap, we develop organization design principles by which the focal venture can manipulate the innovation ecosystem around it toward simultaneously achieving internal alignment in the ecosystem, and external viability of the ecosystem in the broader socio-technical environment. Specifically, we theoretically synthesize the principles developed in the literature on strategic niche management (Raven, 2007) with approaches to innovation ecosystem management (Adner, 2012). We arrive at a list of five theoretical propositions for organization design which empower the focal venture, but target the organization that lies on the network (the ecosystem) level. The propositions are substantiated via illustrative case studies from pre-existing literature. The main contribution of this study is toward the literature on innovation ecosystems, as we (a) identify the objects of manipulation in an innovation ecosystem design, and (b) explicitly consider

the socio-technical viability of the innovation ecosystem around a path-breaking innovation. The corresponding research question in the first study is:

How can a focal venture manipulate its innovation ecosystem to achieve higher socio-technical viability of the ecosystem (and with that, of its own innovation)?

Sub-question 2

In the **second study (Appendix 2)**, we adopt the viewpoint of an incumbent firm, aiming to develop a strategic capability for major innovation. The industry context in this study is the power utility industry, which is currently undergoing a socio-technical transition. Historically, it has been a slow and rigid industry (Nisar, Ruiz, and Palacios, 2013), but in the course of the transition, incumbent utility firms are exposed to multiple disruptive changes arising from new technologies, new societal expectations, new entrants and climate concerns (Richter, 2013). As a consequence, power utilities are performing significantly lower than they did in the previous (almost entirely) fossil-based energy regime. Academic research and industry reports suggest that, in order to stay competitive, incumbent firms in the industry should become significantly more innovative and thoroughly renew their service portfolios (Accenture, 2015; Klose et al., 2010). However, following this advice is not easy, and there is a lack of knowledge about how utility incumbents can become more innovative. In response, the second study targets the organization design of power utility firms operating in transitioning domains. Specifically, we systematically review the existing body of knowledge (137 academic papers) developed across different industries, about how an incumbent firm can develop a major innovation capability, synthesizing this knowledge to a design framework for a corporate major innovation system. We then contextualize this framework into the setting of power utilities by matching the characteristics of these firms to specific design principles found in the broader framework. A key implication of this study on both levels of synthesis (across industries and within the power industry) is that major innovation requires the implementation of a larger number of (complementary) organizational interventions, as opposed to just one or a few. The practical aim of the study is to empower utility firms to become better at major innovation and thus become more successful at transforming sustainable energy technologies into novel value propositions, thereby

also advancing the transition toward a more sustainable energy system. The corresponding research question in the second study is:

How to design an organizational system that empowers incumbent power utilities for major innovation?

Sub-questions 3

In the **third study (Appendix 3)**, we focus on the design of systemic intermediaries. Intermediaries provide support to the transitioning domain by performing a set of roles, including for example the creation and facilitation of networks, technology assessment, gatekeeping/brokering, and standard-setting (Kivimaa, 2014; Klerkx and Leeuwis, 2009; Van Lente et al., 2003). While these roles, performed in support of the transition and its stakeholders, are increasingly well understood, it is less clear how intermediaries develop their set of support roles; and correspondingly, how to design the intermediary in such a way as to provide optimal support to the transition. These issues arise in particular because intermediaries are recently seen as an important lever in innovation policy implementation (Klerx and Leeuwis, 2009), all the while the support requirements of a domain can be different across industrial and institutional contexts, as well as change over time. Intermediaries thus have to cope with dynamic environments to create (and retain) their relevance. In that respect, the design of an intermediary is likely to require mechanisms of feedback and renewal of the organization and the portfolio of its support activities (Kivimaa et al., 2017), but such mechanisms have not been explored in previous research. Correspondingly, in study three, we analyze the evolution of the transition-supportive roles performed by intermediaries to explicate mechanisms by which intermediary support activities can be dynamically managed and governed. The topic of intermediary design is researched in a single case study of a major systemic intermediary in the European energy landscape spanning the period of 2011-2017. Building on interviews, participant observations and the analysis of several thousand pages of archival materials, we compose narratives on the development of individual transition-support offerings (which we refer to as transition services). We then analyze the evolution of the intermediary on the service portfolio level, and explicate the key mechanisms behind aligning the intermediation activities with the transitioning context over time. The study contributes to literature on systemic intermediaries by furthering theory on transition-supportive roles: what are their

characteristics, how are they developed and how are they combined. The case further demonstrates that a key mechanism for developing transition-facilitating roles is flexible and experimentative service innovation, undertaken in response to specific signals from transition stakeholders about their actual needs for support. However, responsiveness in the intermediary service portfolio appears to assume a particular alignment between the management and the (policy) governance of the intermediary about how to control the activities of the intermediary. As such, the insights in this study explicate an alternative governance approach compared to (a) policy makers monitoring and forecasting the needs of the transitioning domain toward redeveloping intermediary mandates correspondingly (Kivimaa et al., 2017); and (b) individual support schemes being informed by a wide-scale visioning (e.g., roadmapping) effort performed at the cross-section of different stakeholder classes (Kemp, Loorbach, and Rotmans, 2007). This study is exploratory by nature and raises three particular sub-questions:

a) *How do systemic intermediaries develop transition-supportive roles?*

b) *What are the mechanisms that guide change in the (combinations of) transition-supportive roles that systemic intermediaries perform?*

c) *What are the organizational and governance conditions that enable dynamism in the set of transition-supportive roles a systemic intermediary performs?*

Sub-question 4

The **fourth study (Appendix 4)** stands out from the other three in that it assumes the viewpoint of no one particular actor class. Instead, the study is aimed at developing a generic method for designing networked organizations, potentially involving all of the aforementioned classes of organizations. The method concerns the design of one particular type of networked organization: the innovation ecosystem, defined in line with study one as a network of interdependent actors who combine specialized yet complementary resources and/or capabilities in seeking to (a) co-create and deliver an overarching value proposition to end users, and (b) appropriate the gains received in the process (definition developed in study one). In particular, we contribute to innovation ecosystem research and managerial practice by developing design theory (Gregor and Hevner, 2013; Gregor and

Jones, 2007) directed to mapping, designing and analyzing ecosystems surrounding embedded value offerings (Adner, 2016; Adner and Kapoor, 2010). The need for such a design theory arises from the somewhat ironic state of discourse in innovation ecosystem literature. Namely, academic research, along with works in popular science has claimed that the ecosystem setting fundamentally changes the nature of innovation strategy and that there is a long list of (new) considerations managers need to have with regard to their innovation ecosystem (Adner, 2006; Adner and Kapoor, 2016; Autio and Thomas, 2014; Davis, 2016). Authors have also made specific reference to significant additional value that can be created by carefully designing complementarities between different organizations (Dattée, Alexy and Autio, Forthcoming; Kapoor and Furr, 2015; Moore, 1998). As such, ecosystem-based innovation can be a major driver in sustainability transitions, speeding up the successful development and commercialization of new more sustainable (sub-)system configurations (Ceschin, 2013; Hellström et al., 2015). Meanwhile, there is a lack of practical knowledge and tools on how then to operationalize the list of either threat-reducing or opportunity-seeking considerations related to ecosystems and actually capture, analyze and ultimately design the specifics of any particular innovation ecosystem. In this essay, we argue that a formally-developed design theory, which constitutes an integration of the normative and descriptive theories on innovation ecosystems into design paths intended to produce more effective organizational systems (Gregor, 2006), helps to bridge the aforementioned gap.

Following the formal anatomy of a design theory (Gregor and Jones, 2007), we synthesize the scholarly knowledge base on innovation research into relevant design constructs and their relationships, and devise a comprehensive model of the innovation ecosystem concept. Subsequently, we propose an instantiation to the model in the form of a modeling tool, and provide principles for its use. The tool and its principles of use are tested in empirical mapping, designing and/or analyzing a total of 241 existing or potential ecosystem constellations over seven development iterations, which drive mutability of the design theory. Based on four case studies originating in the modeling events, we then illustrate the application of the design theory across different modeling contexts, distinguishing use cases for ecosystem modeling that are either retrospective or prospective, and conducted either by ecosystem internal or external modelers. As such, we find support for the generalizability of the method developed in this study. The study contributes to empowering managers and scholars directly (via tool interaction) to engage with organization design and analysis of innovation ecosystems. The

corresponding research question of the fourth study is:

What is the design theory that informs efforts by managers and scholars to map, design and analyze (i.e., model) innovation ecosystems?

Transition studies as a research field has traditionally concentrated on developing policy implications (Fischer and Newig, 2016; Kemp, Loorbach and Rotmans, 2007). In contrast, the current dissertation features an actor-based approach to innovation in transitioning domains. This in itself is not a novelty: the actor-based perspective is receiving increased scholarly attention within transition studies. However, while actor-based strategies are by now rather commonplace in transition studies (Penna and Geels, 2012), the question of designing organizations in a specific way to actually accomplish these strategies has been largely neglected. In this dissertation, the core contribution made to transition studies is to develop organization design oriented knowledge that complements the actor-based strategies as found in transition studies. This contribution is further enhanced in two different ways. First, corresponding to the position of different actor classes to the transition processes, we distinguish and elaborate organization design for three different classes of organizations that are operating within transitioning domains. Second, by adopting the viewpoint of particular organizations and by gearing the studies in this dissertation toward generating prescriptive knowledge, much of the work in this dissertation aims to be applicable to practitioners with less necessity of 'translation' than is commonplace in organization studies and transition studies otherwise. More detailed contributions for each particular study and the overall dissertation are articulated in respective studies, as well as in the Conclusion section.

1.3. Research approach: design science

Dimov (2016, p. 28) reflects on choosing the most appropriate mode of research as follows: "From the position of the present, at the interface between past and future, one can look in two directions: towards the past, to make sense of what has happened, or towards the future, to enact a purpose" (2016, p. 28). As is evident in the overall research question and each of the four sub-questions, this dissertation is oriented toward creating prescriptive knowledge; and as such, is positioned within the latter of the research directions articulated by Dimov. Meanwhile, drawing from research that is predominantly positivist or construc-

tivist, the vast majority of work in the organization and innovation sciences is descriptive, explanatory or predictive in nature (Hodgkinson, Herriot, and Anderson, 2001; Romme et al., 2015). In such inquiries, validity is the grand goal of inquiry (Denyer, Tranfield, and Van Aken, 2008). However, the power of conventional research methods in developing prescriptive knowledge toward real-world change is limited (Romme, 2003; Simon, 1996). A more appropriate lens for developing prescriptive knowledge that enacts a purpose (Dimov, 2016) is found in the design science approach (Denyer et al., 2008; Hodgkinson and Healey, 2008; Romme and Endenburg, 2006; Van Burg and Romme, 2014), which has been adopted as the underlying research strategy in each of the four studies in this dissertation.

Design science, also known as science-based design (Van Burg et al., 2008) is a research tradition that fundamentally assumes organization and management studies to be problem-driven and solution-oriented (Hodgkinson et al., 2001; Holmström, Ketokivi, and Hameri, 2009; Nicolai and Seidl, 2010). The aim then is to develop knowledge that can be used to improve real-world situations by designing and testing practical solutions (Van Aken, 2004). The ultimate goal of design inquiry is thus to create change, drawing on the notions of pragmatic validity and relevance (Romme, 2003; Worren, Moore, and Elliott, 2002). Or put otherwise, the task in design science is to develop knowledge and artifacts that work, and fulfill a certain real-world purpose (Simon, 1996), such as building effective organizations that thrive in socio-technical transitions. As such, design science research activities are typically performed in the interface of traditional organization and innovation research and managerial practice, seeking to bridge the two domains. The main means to achieve that end is to develop boundary objects that position on the interface of research and practice. In particular, there are two major types of boundary objects: design principles and design solutions (see Figure 1.1) (Romme, 2003).

Design principles are general normative statements that are predominantly based on research findings and that serve to outline the design space for developing any directly usable real-world interventions (Denyer et al., 2008; Van Burg et al., 2008). Design principles typically come in a set of related principles, each informing different aspects of a proposed generic design (Romme and Endenburg, 2006). The principles are generated either by means of a synthesis from the existing scholarly knowledge base (i.e., contextualization), or alternatively by decontextualizing practice via particular design solutions (see Figure 1.1) (Van Burg et al., 2008). In the context of this dissertation, study one features a set of

design principles as the primary outcome of the study. More specifically, in study one, the design principles are developed predominantly from theory by means of contextualization.

Within the design space outlined by the (preliminary set of) design principles, scholars and/or practitioners can proceed to build contextualized design solutions. This boundary object serves to convert design principles from their relatively generic form to a system of (re)designed practices for a particular context. Unlike design principles, design solutions are therefore informed and justified by the specific characteristics and circumstances of the actors engaging in the (future) application of the design knowledge (Romme, 2003). As such, design solutions can materialize as schemes, narratives, simulations, tools, or lists of potential actions, all serving to inform managerial action (Romme and Endenburg, 2006). While not the intervention in itself, a design solution should feature a level of implementability that allows for the design knowledge to be put into practice with relative ease. In the context of this dissertation, studies two, three and four feature examples of design solutions as (one of the) key outcomes of the studies. More specifically, in study two, a design solution is developed by means of contextualizing scholarly knowledge first to design principles across sectors and then further toward an actionable design solution for a specific organizational profile. In study four, the design solution takes the form of a modeling tool, which empowers the mapping, designing and analyzing of a particular type of organization: the innovation ecosystem. Contrastingly, in study three, a design solution is captured from practice (Van Burg et al., 2008) with the perspective of future work further decontextualizing (or again contextualizing) it.

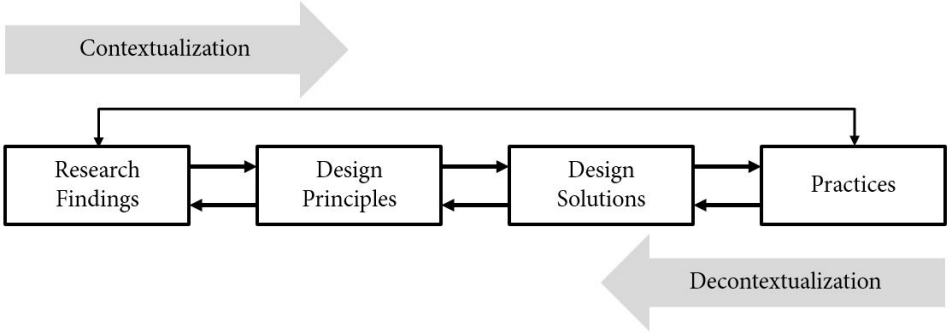

Figure 1.1. *The science-based design cycle (source: Van Burg et al., 2008, p. 117)*

In addition to having a strong focus on generating knowledge of the prescriptive kind, design science features two other aspects that make its application in the context of the current dissertation desirable. First, approaching organization design with a design science lens enables the integration and synthesis of dispersed streams of scholarly literature. In this respect, as the aim of boundary objects in design science is to provide knowledge for bringing about real-world change, both the design principles and design solutions are inherently agnostic as to which particular stream of research a piece of knowledge originates from, as long as it contributes to the desired real world change. Furthermore, the contextualization exercise by which design knowledge (i.e., on Figure 1.1, movement from left to right) is created concerns little about the methods and the forms of data in the studies that implications are drawn from. This stands true as long as the original analyses were conducted in a rigorous fashion (Rousseau, Manning, and Denyer, 2008). Consider, for example, the central phenomenon in study two: incumbent major innovation (capability). The academic literature on this phenomenon features over 5000 peer-reviewed contributions that span over four decades, over relatively disconnected research domains, such as organization design (Brettel et al., 2011), corporate finance (Hill and Rothaermel, 2003), new product development (von Hippel, Thomke, and Sonnack, 1999), marketing (Veryzer, 2005) and strategy (Christensen and Raynor, 2003), and make use of a long list of different conceptual lenses. Considering that achieving major innovation remains a real world challenge for managers, it is paramount that developing a framework toward addressing this challenge does not follow the largely conceptual demarcation lines drawn by researchers. Instead, a design science driven synthesis would keep in mind the real world phenomenon, and integrate scholarly knowledge across the different research streams, methods and types of data in the service of bettering the condition of managers interacting with the real world phenomenon. Such a process is illustrated in the systematic literature review protocol in study two, as well as in studies one and four.

Second, both the design science research process and the resultant design knowledge are an adequate basis for inviting engagement of practitioners in research. In particular, the notion of pragmatic validity implies that the strength of a design science output is measured prominently by how well it contributes to real world change. As such, the design science tradition places significant emphasis on testing the design knowledge in practical contexts, and adjusting the design knowledge based on received feedback (Van Aken, 2004). Achieving the ideal, which would be to place the development of design knowledge and the subse-

quent measuring of the long-term effect of the design science informed intervention into one single study, is difficult because of temporal issues (Romme, 2016). However, implementing design knowledge also offers opportunities for observing short-term effects. Assessment points can be placed to measure the face value of design knowledge, feedback from partial implementations, interim results, et cetera (Romme, 2016).

All this assumes that practitioners are willing to interact with the creation and implementation of the design knowledge. From the experience of conducting the studies in this dissertation, two particular conditions appear to increase that willingness. First, a design science research effort should assume a problem that practitioners find relevant and challenging (Van Aken and Romme, 2012)—a condition we have held in high regard across all four studies.

Second, understanding why design knowledge is expected to work appears to invite the attention and reduce the anxiety of practitioners in implementing the knowledge. The latter point was particularly evident in composing study two, which heavily uses the mechanism-based explanation format known as *CIMO* -logic (Denyer et al., 2008), that supplies the structure by which it is explicated why a certain intervention in a certain context is expected to lead to certain outcomes. Repeated engagements with practitioners serve both to validate and to disseminate research results, both of which are desirable traits for prescriptively oriented research, and have stood as core goals during the composition of this dissertation.

The dissertation includes four studies as listed below which are further summarized in Table 1.1:

1. Walrave B., Talmar M., Podoynitsyna K.S., Romme A.G.L, Verbong G.P.J. (Forthcoming). A multi-level perspective on innovation ecosystems for path-breaking innovation. *Technological Forecasting and Social Change*. In Press.
2. Talmar M., Walrave B., Holmström J., Romme A.G.L. (2016). Can elephants still dance? Major innovation in incumbent power utilities. *Proceedings to the Acedemy of Management Annual Meeting 2016*, Anaheim, August 5-9, 2016, Pg 1-40. [1]
3. Talmar M., Walrave B., Raven R.P.J.M., Romme A.G.L. (2018) Intermediary role dynamics in system-level transitions. *Working paper*. Pg 1-45.
4. Talmar M., Walrave B., Podoynitsyna K.S., Holmström J. (2017) Mapping, designing and analyzing innovation ecosystems. *Proceedings to the International Product Development Management Conference 2017*, Reykjavik, 11-13 June, 2017, Pg 1-40.

1.4. Outline of dissertation

Studies one to four (found as Appendix 1-4) represent distinct research essays on organization design for innovation in transitioning domains, each responding to specific research questions/objectives (defined earlier in this chapter). These research essays report upon separate research projects, conducted to target respective research gaps. All the four studies are thus also written to (possibly) be read independently of each other. Consequently, some overlaps of definitions, assumptions and argumentation can be found, as well as some conceptual diversity. Following the studies, the Conclusion chapter presents the overall conclusion of the dissertation, managerial implications and suggestions for further research.

1 The version of study two submitted to the Academy of Management Annual Meeting 2016 had a different title: "*Major innovation in energy incumbents: A science-based design approach*"

1.5. Contribution of authors

This dissertation has been written by doctoral student Madis Talmar in collaboration with supervisors and co-authors. Table 1.2 presents an overview of the contributors to respective studies.

Table 1.2. *Contributions of authors*

		Design of the study	Literature review	Data collection	Data analysis	Interpretation of results	Writing main text	Corrections and feedback
Introduction	*Madis Talmar*						X	X
	Bob Walrave							X
	Georges Romme							X
Study 1	*Madis Talmar*	X	X				X	X
	Bob Walrave	X	X				X	X
	Ksenia Podoynitsyna							X
	Georges Romme	X						X
	Geert Verbong							X
Study 2	*Madis Talmar*	X	X	X	X	X	X	X
	Bob Walrave							X
	Jan Holmström							X
	Georges Romme							X
Study 3	*Madis Talmar*	X	X	X	X	X	X	X
	Bob Walrave							X
	Rob Raven							X
	Georges Romme							X
	Freek Meulman			X				
Study 4	*Madis Talmar*	X	X	X	X	X	X	X
	Bob Walrave							X
	Ksenia Podoynitsyna	X						X
	Jan Holmström	X						X
Conclusion	*Madis Talmar*						X	X
	Bob Walrave							X
	Georges Romme							X

Table 1.1. *Summary of the studies in this dissertation*

	Study 1	Study 2
Title	A multi-level perspective on innovation ecosystems for path-breaking innovation	Can elephants still dance? Major innovation in incumbent power utilities
Organization in focus	Venture pioneering a path-breaking innovation	Incumbent firm challenged by a transition
Research question/ objective	How can a focal venture manipulate its innovation ecosystem to achieve higher socio-technical viability of the ecosystem (and with that, of its own innovation)?	How to design an organizational system that empowers incumbent power utilities for major innovation?
Literature base	Innovation ecosystem research; strategic niche management; strategic management literature	Incumbent major innovation research across different research domains (new product development, strategy, organization design, marketing, operations management, etc.)
Methodology	Developing design principles by conceptual argumentation and case illustrations	Synthesizing evidence-based design principles from performing a systematic literature review; then translating these toward a design solution
Theoretical contributions toward	Innovation ecosystem research (within the structuralist perspective)	Incumbent major innovation research; corporate policy for energy incumbents
Publications/ conference presentations	Published in: *Technological Forecasting and Social Change.* Previously presented at: *Academy of Management Annual Meeting 2015; EGOS Colloquium 2014; International Entrepreneurship Exemplars Conference 2013.*	Previously presented at: *European Supply Chain Forum Annual Meeting 2017; Academy of Management Annual Meeting 2016; 4th KIC InnoEnergy Scientist Conference 2015; TRAIL conference 2015.*

Table 1.1. *Summary of the studies in this dissertation (continued)*

	Study 3	Study 4
Title	Intermediary role dynamics in system-level transitions	Mapping, designing and analyzing innovation ecosystems
Organization in focus	Systemic intermediary aiming to support a transition	Innovation ecosystem in a general sense
Research question/ objective	a) How do systemic intermediaries develop transition-supportive roles? b) What are the mechanisms that guide change in the (combinations of) transition-supportive roles that systemic intermediaries perform? c) What are the organizational and governance conditions that enable dynamism in the set of transition-supportive roles a systemic intermediary performs?	What is the design theory that informs efforts by managers and scholars to map, design and analyze (i.e., model) innovation ecosystems?
Literature base	Transition studies, specifically research on systemic intermediaries	Innovation, organization and marketing studies; in particular innovation ecosystem research
Methodology	Describing a design solution and its enablers based on an exploratory longitudinal case study that draws from interviews, participant observations and archival materials	Iterative design theory development involving eleven modeling events and seven iterations with qualitative feedback. In design theory evaluation, four case studies were developed.
Theoretical contributions toward	Systemic intermediary research; policy studies on supporting socio-technical transitions	Innovation ecosystem research (within the structuralist perspective)
Publications/ conference presentations		Accepted to: *Academy of Management Annual Meeting 2018. Awarded Best Paper by reviewers.* Previously presented at: *Innovation and Product Development Management Conference 2017.*

CONCLUSION

2.1. Synopsis

The central question of this dissertation was: *How to design organizations that succeed at innovation in transitioning domains?* Building on transition studies (Raven, Van den Bosch, and Weterings, 2010), we distinguished three particular profiles of organizations involved in a transitioning domain to be in focus of our inquiry: ventures, incumbent (corporations), and systemic intermediaries. Respectively, Appendices 1, 2 and 3 contain individual studies with a shared focus on organization design, for each of these organizational profiles. Finally, in study four (Appendix 4), we addressed the topic of organization design in a more general sense by developing an organization design method that empowers innovation ecosystem mapping, design and analysis regardless of the organizational profile or the affiliation of the organization to a transitioning domain.

Correspondingly, studies one to four were each guided by contextualized sub-questions, which specified the central research question for the particular study. In the remainder of this chapter, we answer these sub-questions, outline key insights arising from each of the individual studies, and summarize the theoretical and practical implications.

2.2. Summary of findings & theoretical implications

Sub-question 1

How can a focal venture manipulate its innovation ecosystem to achieve higher socio-technical viability of the ecosystem (and with that, of its own innovation)?

In **study one (Appendix 1)**, we considered organization design as performed by a venture on the inter-organizational network level. More specifically, we developed strategies that a venture advocating a path-breaking innovation can use in orchestrating its innovation ecosystem toward higher socio-technical viability. As such, the study is at the intersection of the structuralist perspective of innovation ecosystem research (Adner, 2016; Adner and Kapoor, 2016; Dattée, Alexy, and Autio, Forthcoming) and research on socio-technical transitions (Geels, 2004; Raven, 2007; Smith and Raven, 2012), carrying over the principles for developing path-breaking innovation from the latter to the former. To the innovation ecosystem research, the study makes four particular contributions. First, to complement internal development (Adner, 2012), we introduced the concept of

external development of the ecosystem, referring to the deliberate efforts made by ecosystem actors, and particularly the focal venture, directed to enhancing the viability of the ecosystem in its broader socio-technical environment (i.e., external viability). Second, we identified the ecosystem-level objects which a focal venture can manipulate in developing their innovation ecosystem. These are the ecosystem's value proposition and the ecosystem model. Third, we articulated strategies that a focal venture, along with the other ecosystem actors, can employ in manipulating the ecosystem-level objects toward achieving external viability of the innovation ecosystem. These strategies are captured in a set of five theoretical propositions for organization design by means of manipulating the ecosystem-level objects. In particular, the focal actor would (a) learn how to manipulate the ecosystem-level objects from directly interacting with the socio-technical environment via experimentation activities; (b) learn how to manipulate the ecosystem-level objects by means of drawing analogies from their peers (so called inter-local learning); and (c) learn how to manipulate the ecosystem-level objects from the collective agency on the socio-technical niche level, which may lead to a convergence of ecosystem's value propositions and/or ecosystem models on the niche level. In sustaining the development of the ecosystem, the actors would benefit from resource slack and from niche protection mechanisms. Fourth, with the link made in this study between the concepts of socio-technical niche, regime and innovation ecosystems, we explicated a multi-level perspective on innovation ecosystem development. Building on that base, we provided an extensive agenda for future research along the multi-level nature of innovation ecosystem development for path-breaking innovations.

The research further contributes to transition studies by providing an ecosystem-based viewpoint to navigating transitions. In developing specific knowledge toward ecosystem orchestration in transitioning domains, we have clarified the exact positioning and importance of innovation ecosystems within the multi-level perspective of socio-technical transitions (Geels, 2004). The study claims that aside of considering ventures to be the key agent of change on the niche level, supporting transitions should have an explicit focus on empowering the emergence of stronger innovation ecosystems, where effort is turned to designing competitive value creation, delivery and appropriation constellations involving several actors. Or put otherwise, we posit that the strategies leading to the successful composition of an innovation ecosystem should be an area of distinct interest in transition studies. In this respect, it is worthwhile to bear in mind that an innovation ecosystem goes beyond just any collaboration between

different organizations (Adner, 2016). What is assumed is a specific complementarity-based constellation where the offerings of different parties are integrated to the extent that a coherent and competitive value proposition emerges. Doing this in conditions of high uncertainty and relative immaturity of each individual offering is difficult (Dattée, Alexy, and Autio, Forthcoming), but does promise to be an area of high impact to transitions.

Sub-question 2

How to design an organizational system that empowers incumbent power utilities for major innovation?

In **study two (Appendix 2)**, we turned attention to organization design for incumbent corporations operating in a transitioning domain. In particular, we transferred and contextualized the existing body of knowledge on supporting a major innovation capability (O'Connor, 2008) as developed primarily in and for other industries, to the electricity industry. This was done toward helping incumbent power utilities overcome strategic rigidity originating from their previous and existing organizational practices (Nisar, Ruiz, and Palacios, 2013).

We make three contributions to the literatures on management and innovation of incumbents in the domain of energy. First, this study is an addition to the small set of research on innovation in the energy industry from the perspective of utility firms (cf., Jamasb and Pollitt, 2008; Nisar et al., 2013; Richter, 2013, 2012). Within that set, we stand out by significantly deepening the understanding of the various interventional options at disposal of managers in utility companies in designing their organizations toward an increased corporate capability for major innovation. On a more general basis, as one of the few works on innovation policy of power utilities, the perspective of a particular actor extends previous studies that focus on innovation from the point of view of the energy system or the society at large, which are the two dominating viewpoints in energy literature.

Second, we argued that overcoming strategic rigidity and becoming an innovative organization is achieved not by performing isolated managerial interventions or by developing individual innovation capabilities. Rather, building a systematically more innovative firm assumes the design and implementation of an entire organizational system that involves many mutually reinforcing interventions (triggering desirable mechanisms), and spans both the strategic and operational level of the organization.

Third, as a frame for designing an organizational system of innovation in general, we laid out a landscape of alternative interventions that managers can choose from in triggering generative mechanisms toward desirable outcomes associated with incumbent major innovation (capability). For power utility firms in particular, a sub-set of these alternatives were further prioritized, taking into consideration the specific context of the utilities. As such, the study included a framework of potential design solution elements (Romme, 2003) that a particular utility firm can use in designing their version of an organizational innovation system.

Meanwhile, in creating the base for knowledge transfer into the energy domain, the study contributed toward organization and innovation studies in general by including the widest-based and most comprehensive review and synthesis of the major innovation literature to date. We synthesized the existing evidence from 137 systematically selected top level peer-reviewed works on overcoming the incumbent major innovation challenge into a CIMO-based (Denyer, Tranfield, and Van Aken, 2008) design framework. The resultant framework consisted of several hundred individual design principles that represent the causal relationships between contextual factors, managerial interventions, generative mechanisms and outcomes on (a) the development of a major innovation capability in an incumbent corporation (the strategic level), as well as on (b) running particular major innovation projects in incumbents (the operational level). As such, a significant portion of the four decades of research on empowering major innovation in incumbents has been synthesized from the point of view of generative mechanisms, serving as a base for developing context-specific design solutions, as we have done in our study toward one type of stakeholder in transition processes, or for identifying needs for further research in this field.

Sub-questions 3

a) *How do systemic intermediaries develop transition-supportive roles?*

b) *What are the mechanisms that guide change in the (combinations of) transition-supportive roles that systemic intermediaries perform?*

c) *What are the organizational and governance conditions that enable dynamism in the set of transition-supportive roles a systemic intermediary performs?*

In **study three (Appendix 3)**, we turned attention to organization design of systemic intermediary organizations aiming to support socio-technical transition stakeholders in their transition processes. In particular, we performed a longitudinal inquiry into the evolution of a major systemic intermediary in the domain of energy, allowing us to identify how intermediaries design their transition-supportive roles. We found that over seven years, the intermediary significantly extended its service base, and with each new service accomplished new combinations of transition-supportive roles. As such, they accomplished a growing number of transition-supportive roles toward more (in numbers) and more different classes of stakeholders. Moreover, we identified that there were several organizational and governance conditions that enabled the case organization to extend their support base.

The study made the following four contributions to the literature on systemic intermediaries, and more broadly to transition studies. First, we operationalized the concept of transition-supportive roles (Kivimaa, 2014) in analyzing the support activities of an intermediary. Doing so, we turned attention to three previously under-studied facets of transition-supportive roles: (a) transition-supportive roles are not targeted just out there (Kivimaa, 2014), but rather to one or several stakeholder groups in a transitioning domain; (b) roles are rarely performed in isolation, rather, intermediaries combine the performing of several complementary transition-supportive roles in designing specific support services; and (c) in accomplishing a particular service, some transition-supportive roles are central to the aim of the service (primary roles) while others (secondary roles) do not directly perform the aim of the service, but serve to enable or enhance the value of primary roles.

Second, we identified an explicit strategy in intermediation where transition services (accomplishing transition-supportive roles) are developed at the grassroot level in response to the (explicit or implicit) needs of transition stakeholders. This strategy spans both the intermediary organization as well as its governance in that it assumes that transition-supportive roles are not imposed upon an intermediary in their governance, which can often be the case with policy-driven intermediaries. Our work thus demonstrates the potential value of laissez-faire policy with regard to the content of transition support, and that high freedom to design support measures at the intermediary level itself may be an effective way to achieve relevant transition-supportive measures.

Third, we studied the formerly unexplored micro-level dimension of transition-supportive role design. We found that there are significant complemen-

tarities between different transition-supportive roles and between transition stakeholder classes, pointing to the potential of exploiting systemic effects within the activity of intermediation itself. However, role complementarities were not necessarily exploitable in the same fashion across the different services provided by the intermediary. As such, at any specific service design, there was need for dedicated discovery work toward finding the optimal role combination. Our study suggested that such discovery work can be accomplished by designing new transition services in an experimentative fashion and with the close involvement of external stakeholders.

Finally, this was the first study to link intermediation activities to organization design choices. Specifically, we found that there are several enablers that support the repositioning of the systemic intermediary within its transitioning domain, and that the enablers span both the organization and the governance of the systemic intermediary.

Sub-question 4

What is the design theory that informs efforts by managers and scholars to map, design and analyze (i.e., model) innovation ecosystems?

In the **fourth study (Appendix 4)**, we built upon an insight gained from conducting the other three studies of this dissertation. Namely, while organizations are increasingly inter-dependent in innovation and commercialization processes (Adner, 2006; Baldwin, 2012), both managers and scholars lack a comprehensive framework with which to capture, make sense of, and develop strategies for operating within innovation networks. In response to this challenge, study four uses the design theory anatomy of Gregor and Jones (2007) as a base to develop a method for mapping, designing and analyzing (i.e., modeling) innovation ecosystems. This serves to make the following two contributions to the literature on innovation ecosystems in the structuralist perspective (Adner, 2006; Adner and Kapoor, 2016; Dattée, Alexy and Autio, Forthcoming; Davis, 2016).

First, we synthesized the innovation ecosystem literature to distinguish the critical constructs that add value to understanding how a real-world (or a hypothetical) ecosystem functions in terms of value creation, delivery and capture. We further articulated the relationships between these constructs to arrive at a generic model of innovation ecosystems. As we demonstrated in the study, for scholars such an understanding of the constructs and their relationships as a de-

tailed map of the innovation ecosystem phenomenon enables the positioning of existing studies, comparing research results, and subsequently also the framing of future research.

Second, we further instantiated the theoretically synthesized ecosystem model as a graphical decision support tool called the 'Ecosystem Pie Model' (EPM). Compared to previously available tools in innovation ecosystem analysis (Adner, 2016; Hellström et al., 2015), the EPM is a significant step toward capturing the complexity and multitude of the inter- and intra-organizational characteristics that scholars assume relevant in innovation ecosystems (Adner, 2016; Autio and Thomas, 2014; Davis, 2016). The EPM is further accompanied by guidelines for its implementations, which has enabled the application of the EPM as an ecosystem modeling tool to be used relatively independently by individuals outside the circle of the original contributors to study four. To date, such applications include at least five university courses with over 175 participants, nine master or PDEng dissertations, over ten commercial applications in a number of different organizations including several multi-national corporations, consultancy firms, and various research-oriented applications at Eindhoven University of Technology, Aalto University and elsewhere. Application instances have provided the research team with an opportunity to adjust the design theory based on feedback received from its real-life use. As such, the design theory presented in this study goes beyond merely a situated implementation of an artifact (level 1 contribution to design research) and reaches the level of a nascent design theory (level 2 contribution) (Gregor and Hevner, 2013).

Theoretical implications across studies

In addition to the contributions made in the four separate studies, the dissertation makes three overarching theoretical contributions. First, research on socio-technical transitions has not explicitly looked at organization design as an area of importance for organizations in navigating and contributing to a transition. In this dissertation, we considered the link between socio-technical transitions and organization design from the viewpoint of three key profiles of organizational actors affiliated to socio-technical transitions: ventures, incumbents and systemic intermediaries. Results from the various studies in this dissertation indicate that organization design entails different considerations for each of these actors. In particular, this difference is influenced by (a) the dominant goals of the respective organizations, and (b) the challenges that arise for the organiza-

tion from operating within a transitioning domain. For example, in study one, a key goal of ventures was assumed to be the successful market introduction of an overarching value proposition (i.e., a systemic product/service) that is achieved as result of contributions from several entities (i.e., their innovation ecosystem). The challenge associated with achieving that goal was a lack of knowledge on how to manipulate the innovation ecosystem toward accomplishing external viability. Correspondingly, the organization design principles arising from the study targeted the overcoming of that challenge. In comparison, in study two, the central goal of electricity industry incumbents was assumed to be a substantial increase in their capability to perform major innovation, which was seen as a requirement to retaining (and increasing) the relevance of the organizations throughout the unfolding energy transition. For these organizations, strategic rigidity was identified as the central challenge to major innovation. In response, our study explicated how interventions in the area of organization design can contribute to overcoming the strategic rigidity of (energy) incumbents. The three first studies imply that organization design as a deliberate activity performed to overcome certain contextual challenges arising in transitioning domains has merit in all the three profiles of organizations. Thus, we argue that the design of organizations is not only an appropriate, but also a relevant area of inquiry within transition studies; an area which can significantly contribute to empowering transition stakeholders, and ultimately the progress of the transition as a whole. With the exploratively-oriented studies one, two and three of the current dissertation, we have laid the groundwork for the proposed new sub-domain of transition studies in such a way as to include three major classes of stakeholders operating and contributing to a transitioning domain as an explicit object of interest.

Second, in 2012 Carliss Baldwin pointed at the necessity to consider the design of interactions across actor boundaries as an inherent part of organization design. Building on Baldwin's argument, this dissertation turned focus on the design of a particular kind of organizational system: the innovation ecosystem (in the so called structuralist perspective) (Adner, 2016). Our five main contributions to the ecosystem research domain are built upon each other across studies one and four, where we (1) introduced to ecosystem research the concepts of external viability and external development of an ecosystem and explained the necessity of performing internal and external development hand-in-hand; (2) argued that in performing ecosystem development, an ecosystem orchestrator has two objects of manipulation: the ecosystem's value proposition and the ecosystem model around the value proposition; (3) further specified the elements

and their relationships that commonly explain how a real-world (or a hypothetical) ecosystem functions in terms of value creation, delivery and capture, and thus expand the ecosystem model concept to its relevant parts; (4) developed a design theory that encompasses a method for modeling innovation ecosystems across its relevant elements and their relationships; and (5) as a distinct deliverable of this design theory, created and tested a graphical tool that can benefit the innovation research and practitioner audiences in a number of ways (see Figure 6.8). As such, the overall contribution to the innovation ecosystem literature lies in building the foundation for considering innovation ecosystems as objects of design. As part of that basis, the five points above constitute prescriptive knowledge that future research can build on in capturing, understanding and manipulating innovation ecosystems and in helping managers develop increasingly more accurate ecosystem strategies.

Finally, this dissertation carried over from management information systems research to organization and innovation studies the concept of design theory as an integrated boundary object. In Figure 1.1, building on the works of Romme (2003) and Van Burg et al. (2008), we presented the classical differentiation of the types of boundary objects in design science within organization and innovation studies. Specifically, that entails distinguishing between design principles and design solutions as two distinct positions on the scale from general to contextual design knowledge. In developing prescriptive knowledge from research, the former is a commonly occurring outcome in theoretical studies and in studies aimed at synthesizing research results (e.g., Hill and Rothaermel, 2003; Dhanaraj and Parkhe, 2006; Romme and Endenburg, 2006). In the dissertation, respective examples are found in studies one and two. Meanwhile, design solutions can be found in organization and innovation research to emerge either from studies that describe particular real-life organizational systems in their key features (e.g., Leifer et al., 2001; study three of the dissertation), or from studies that (based on design principles) explicitly develop actionable knowledge for a specific context (e.g., Van Burg et al., 2008; Van Burg and Romme, 2014; study two of the dissertation).

In contrast to the nature of either of these boundary objects and the research strategies leading to them, in study four we have taken the role model of design theory and its development in management information systems (Gregor and Jones, 2007) and adapted it to the context of organization and innovation studies. As defined in study four, the resultant design knowledge is content-wise an integration of the relevant normative and descriptive theories into design paths

intended to produce more effective organizational systems. The added value of developing a design theory in place of (or in addition to) the traditional two levels of boundary objects appears to be twofold. First, involving eight connected building blocks (Gregor and Jones, 2007), a design theory lays a path for how exactly is design knowledge built up methodologically, involving steps from clearly defining the purpose and scope of the theory, to identifying the constructs of interest and their relationships, to developing instantiations and guidelines for use. As such, a design theory is not only outcome-driven (i.e., useful knowledge for producing more effective organizational systems), but structures also the process of developing design knowledge. Rooted in the previous, the second value in adopting a design theory lies in the clarity with regard to all the elements composing and leading to the design knowledge. As a result, transparency and transferability is created, allowing a particular design theory (i.e., one with a particular purpose and scope) to be developed across different scientific works and by different authors. In fact, one of the anatomical components of a design theory (i.e., artifact mutability) inherently assumes multiple applications feeding back into the design theory, making it an evolving entity. The benefits of a design theory as an integrated boundary object in the particular context of ecosystem modeling were covered in study four. With regard to other applications of the design theory framework, it remains to be tested in which conditions are design science efforts within organization and innovation studies better served by adopting still the classical dichotomy of design principles and design solutions, and in which the integrated approach of developing a design theory. Nevertheless, we believe the latter to be a potentially valuable addition to the arsenal of design scientists and worth the consideration upon initiating new pragmatically-oriented research projects.

2.3. Limitations and future research

In addition to the limitations and future research areas articulated in each individual study, the following limitations and research opportunities apply.

First, drawing from the definition of organization design (see Introduction) as 'involving the deliberate process of configuring structures, processes, reward systems, people practices and policies' (Galbraith, Downey, and Kates, 2001, p. 2), each of the studies within this dissertation has only targeted a subset of the topics composing the domain of organization design. Opportunities for future research thus arise in extending the focus areas to capture more elements of con-

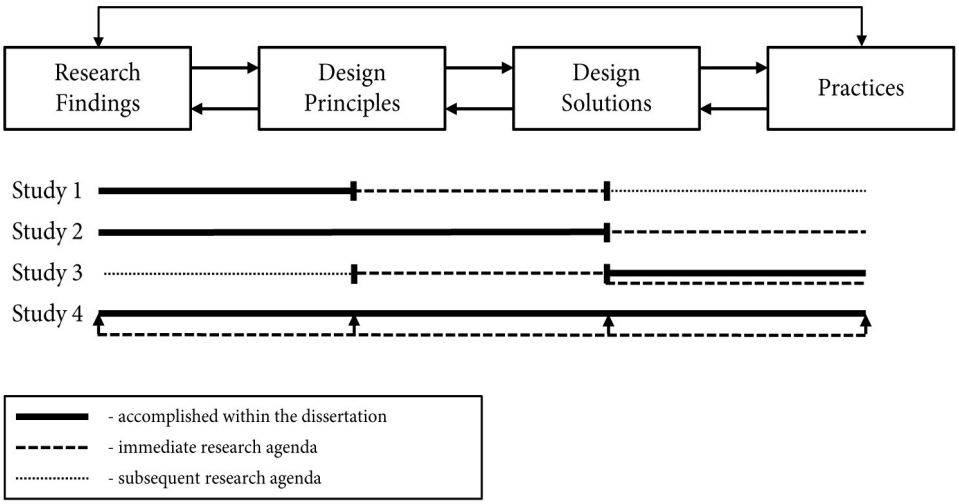

Figure 2.1. *Future science-based design research agenda as emerging from the four studies*

figuring organizational systems in particular contexts. In that respect, the most complete representation of the domain of organization design is found in study two, where all five of the organizational design areas were explored. In contrast, in study one and study four we focused on configuring structures and processes, and to a lesser extent policies, leaving the areas of reward systems and people practices in similar organizational circumstances for future research to explore. Meanwhile, study three emphasized processes, reward systems, policies and to a lesser extent people practices, but did not turn explicit attention to the topic of structures, which we nevertheless expect to be a potentially fruitful area of exploration in future research on systemic intermediaries.

Second, achieving one or more full science-based design iterations (see Figure 1.1) within the boundaries of one academic study is generally considered difficult, specifically due to the time lag associated with developing, validating and refining design knowledge (Romme, 2016). In light of that limitation, we were able to complete a full science-based design cycle in only one of the four studies in this dissertation: study four. In the other three studies, our research only involved some of the steps in the cycle, implying the need for future research in further developing the enclosed design knowledge. This is the case for two reasons. First, because any science-based design effort is targeted toward application (Simon, 1996), without specific follow-up studies along the science-based design cycle (see Figure 2.1) the main aim of design research would remain unattainable. Second, to properly evaluate the output of design science research as either

good or bad, one needs to confront a proposed design with the results achieved from implementing it (Dimov, 2016). Thus, specifically for the results arising from study one in which we developed design principles from theory, future work would need to apply these design principles in practice and subsequently empirically validate their validity and usefulness. In doing so, the immediate research aim might involve contextualizing the principles first toward a design solution within a particular socio-technical niche and/or a particular ecosystem type, followed then by real-world application in ecosystem orchestration. Similarly, practical application would also be the next step for further developing the design knowledge in study two. However, unlike in study one, we have made an extra step toward a managerial application by contextualizing the design principles arising from other industries to the specific setting of the utility business. With regard to future research arising from study three, we have in this dissertation developed context-specific knowledge on the organizational design of a systemic intermediary. Thus, the next step in research would be to decontextualize that working design solution to a set of more general design principles. Meanwhile, future in-depth (longitudinal) case studies on the organizational design of systemic intermediaries would likely inform (work on) the composition of any such set. Finally, for the design theory proposed in study four, where we already completed several full design iterations, a critical next step is to further decouple the theory development from its original co-authors and make it accessible and testable to wider audiences. This may involve future contributions in any of the sections of the science-based design cycle. In that, either the design theory itself may become subject to refinement, or the implications (both theoretical and practical) arising from applying the theory.

Third, across the four studies, we used different research methodologies, including conceptual argumentation, systematic literature synthesis, qualitative-empirical inquiry, and design theory development; all within the frame of the science-based design cycle (see Figure 1.1). Furthermore, we have drawn on several types of data, including interviews, archival materials, survey data, participant observationgs, and the findings of other researchers. Nevertheless, any particular study only uses a subset of these methodologies and data types. Thus, within the research program that links certain organizational challenges in a transitioning domain and the effectiveness of organization design interventions in tackling these challenges to succeed in a transition, future research should feature a significant expansion of the methodological base in researching each of these organizational profiles.

Fourth, in our studies, we have connected the profiles of organizations operating in transitioning domains to specific types of goals and respective challenges. Future research could explore the goals and challenges of these organizations further. With that, new areas for deliberate organization design as a means to empower an organization to operate in a transitioning domain are likely to be found, extending the results of this dissertation. Although we advocate this thread of inquiry as a future part of transition studies, we see it important for these inquiries to maintain one key difference from mainstream transition studies. Namely, from a societal perspective, a transition is not only seen as potentially taking several decades, but also constituting a goal in itself, with the fate of any involved actor being of secondary priority. In contrast, particular organizations are usually strongly driven by an interest for their own wellbeing, with their goals and strategies involving a much shorter time horizon. For many parties involved in transitions (e.g., ventures and incumbent corporations), that time horizon is rarely longer than a few years, and can be as short as a few quarters. As such, there may be a systemic discrepancy between the grand goal of a transition and the fact that particular organizations, especially if driven by (commercial) self-interest, aim for what would be considered at best rather small and/or inconsistent contributions to the transition. However, within the organization design lens as employed in this dissertation, the aim would nevertheless be to empower organizations that operate in transitioning domains to foremost thrive in the frame of their own goals, with the transition serving as the broader context. Or put another way, the extent that an effort in organization design would include an aim towards becoming more of a 'transition taker' or a 'transition maker' would be dependent on the distinct goals of each individual organization. Nevertheless, although not explored here, there may also be merit in investigating organization design as part of transition studies from the perspective of the transition itself. Key questions in that area of inquiry might include for instance: what kind of organizational formats are more effective in organizing (learning) interactions between the different actors in a niche; or, being the (local) government, how to stimulate the emergence of desirable organizational constellations around particular innovation areas.

Finally, this dissertation did not explicitly explore organization design from the viewpoint of two additional classes of organizations involved in transition processes: governmental institutions and incumbents with a background in other industrial domains (regimes). Of these, the possible influence of governmental institutions on organization design (for innovation) was to some extent included

in study three, as part of the conditions set for intermediaries to operate. Future work needs to address the design of effective governmental policies and interventions more systematically. Meanwhile, as a more recent area of inquiry in transition studies, a very interesting area for future research is to include the role and organization design of incumbents from other regimes, as agents of change in transition processes.

2.4. Practical implications

The overall research approach in this dissertation is science-based design. As also inherent to the format of our research (sub)questions, the four studies served to create prescriptive knowledge to improve managerial practice. In Figure 2.1, we have summarized the maturity level of the prescriptive knowledge from the respective studies, to argue that toward full managerial implementability of the design knowledge, there is a need for future research. There are, nevertheless, several managerial implications that can be extracted from the studies in this dissertation already.

In study one, we pointed to the specifics that operating in transitioning domains entails for ventures orchestrating a path-breaking innovation ecosystem. The study makes three managerially oriented implications. First, it is important for venture managers to simultaneously keep in mind both internal alignment and external viability of their ecosystem. In other words, agreeing with partners to the composition of a systemic product of some kind, and then accomplishing that product does not imply that the product will be a success. And in reverse, finding a (potentially) valuable systemic product composition does not necessarily mean that the parties are aligned to accomplish it. Rather, these two dimensions should be considered as inseparable and developed in parallel. Second, in developing the ecosystem internally toward alignment, the venture should build several learning loops with the broader environment around the ecosystem, including the socio-technical niche level. Third, in developing the ecosystem internally based on the lessons from the environment, the venture should consider their innovation ecosystem as subject to deliberate manipulation (attempts). In particular, they can either attempt to influence (a) the overarching value proposition of the ecosystem, or (b) the ecosystem model, which refers to the structure of how the ecosystem as a network creates and delivers value, and how value is appropriated by the actors in it.

The insight on two objects of ecosystem manipulation was further extended in study four, where we aimed to empower practitioners to map, design and analyze (i.e., model) innovation ecosystems in a significantly more detailed fashion. Nowadays, most innovations by any single entity are (inter-)dependent on external actors and systems. Any firm should thus consider how does their (intended) innovation fit into the meshwork of external products/services, business models and organizational structures (Adner, 2006, 2016; Dattée, Alexy and Autio, Forthcoming) and, if necessary, take measures to influence oneself or others to increase that fit. To date, managers might have even known the importance of these considerations, but there have nevertheless been no tools to actually comprehensively model particular ecosystems. Study four of this dissertation developed such a tool, coining it as 'Ecosystem Pie Model' (EPM), making it possible for managers to: (a) perform informed strategy-making where the complex interactions in an innovation ecosystem are naturally taken into account; (b) conduct co-creation of the future real-world ecosystem structure together with the actors that are expected to partake in it; and (c) visually represent innovation ecosystems. For ease of managerial adoption and clarity regarding the process of practical ecosystem modeling, we developed a guidelines document that walks a user through all the necessary steps in modeling an ecosystem and in making decisions based on the model. Moreover, in addition to managers in business organizations, the same tool empowers organizations responsible for policy implementation (e.g., conducting public tenders, distributing subsidies, intermediating innovation, etc.). Using the EPM there adds value to the understanding of shortcomings in present innovation ecosystems and can guide policy to interventions that alleviate the exact bottlenecks that are keeping desirable ecosystems (such as widespread smart grid applications, or circular material loops) from achieving their full potential.

From study two, the main message to practice is that individual interventions with regard to organization design characteristics are unlikely to lead to substantial gains in innovativeness of the incumbent organization that struggles with strategic rigidity. The reason is that strategic rigidity as an inhibitor to major innovation is a multifaceted problem, typically arising from the interaction of organizational structures, processes, cultural beliefs, reward systems, and internal and external network ties of the organization. Overcoming strategic rigidity therefore also assumes a systemic approach, where multiple interventions simultaneously target several parts of the previous organizational system. In study two, we identified eleven broad categories of desirable mechanisms in building

a major innovation capability and running a particular major innovation project. Each of the broad mechanism categories further entails lower level mechanisms, triggered by contextual factors or managerial interventions. As such, on Figures 4.1, 4.2 and 4.3, we have laid out a whole landscape of design principles that managers can use in developing their contextualized design solutions. Specifically toward implementation in power utility companies, we have also taken a step further and developed a mid-way contextualized design solution already, presented in Tables 4.1, 4.2 and 4.3.

Finally, a key implication arising from study three is the importance of alignment between how policy-makers guide and control an intermediary, and how its managers design and run the organization. In particular, if the policy-maker does choose to explicitly stay clear from assuming and mandating certain transition-roles upon an intermediary and instead provides the freedom for the intermediary to sculpt its own activities, then front-line employees (i.e., employees who interact with external stakeholders) also need to be empowered to take notice of stakeholder needs and to be able to develop services in response. This implies several complementary conditions inside the organization, including the hiring of entrepreneurially-oriented staff, maintaining a culture that encourages personal initiative, the availability of funding for developing and testing new services, as well as low levels of behavior control within the process of new service development.

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Madis Talmar was born on 21st March 1987 in Tallinn, Estonia. He graduated Pärnu Sütevaka Gymnasium of Humanities cum laude in 2006 and proceeded then to study business administration (graduated cum laude bachelor level in 2009) and management (graduated cum laude master level in 2011) in Tallinn University of Technology. In the period 2006-2013, Madis established several businesses, worked as an international marketing manager in the family company Falco, and taught economics and entrepreneurship in two Estonian high schools. Since 2013, he has taken turns residing in The Netherlands and in Finland, pursuing double PhD degrees at Eindhoven University of Technology and Aalto University. He is a member of the Select+ PhD Programme, Beta Research School and EIT InnoEnergy PhD School. Presently Madis works as a lecturer in Eindhoven University of Technology and Jheronimus Academy of Data Science. In 2017, Madis also co-established the corporate innovation consulting agency Hatch-22 B.V. In his capacity as a consultant, he is a frequent workshop facilitator, drawing from the methodologies of ecosystem modelling, LEGO® SERIOUS PLAY® and Innovation by Design. Madis has been a long-time contributor to the Estonian management journal Director with more than 35 published articles and one co-published book since 2008. Academically, he has published in the journal Technological Forecasting and Social Change. Recently, Madis was awarded the third place at the business concept competition Iberdrola Challenge 2017.

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